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Determinants of Current Account Deficit in Turkey: The Conditional and Partial Granger Causality Approach

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Abstract

This study aims to reveal the causality relations between the macro aggregates that affect current deficit using conditional and partial Granger causality test. Current deficit/GDP, growth rate, real effective exchange rate, direct foreign capital investment, openness, and energy import were selected as variables for this purpose. 2003.1-2014.2 quarterly data for Turkey's economy were used for analysis. The results of the conditional and partial Granger causality test demonstrate that real effective exchange rate is the variable with greatest impact on current deficit/GDP. Exchange rate is followed by the growth rate, energy import, and openness variables. And direct foreign capital investment is the variable with the least impact.

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1. Introduction

Recently, current account deficit has been among the most highly debated issues in Turkey's Economy. Changes in current account deficit are perceived as signals for economic trends and thus, play a decisive role in shaping economic decisions and expectations. Hence is the need to monitor the changes in current account deficit and to study its causes or the determinants of current account deficit.

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Mainly during the 2000s, current account deficit started to constitute a risk for Turkey's economy and increasingly became an element of vulnerability. Among the main causes of the current account deficit problem, which rapidly exacerbated in the 2000s, are the overvaluation of the Turkish lira as a result of inflation targeting, as well as increasing foreign trade deficit, increased dependence on imports in production and exports, the ever increasing foreign dependence in energy consumption, and the delayed effects of the Customs Union, which came into effect in 1996 (Esiyok, 2012:64). Furthermore, in Turkey, the basic determinant of current account deficits, which are also defined as the difference between domestic investment and saving, is the low saving rates that tend to decrease continuously. There has been a persistent need for foreign resources since domestic savings fall short of financing actual economic growth.

From 2003 to the global financial crisis in 2008, current account deficits in Turkish economy were mainly financed by long-term capital inflows and direct foreign investments. Such financing scheme has been a significant determining factor in the sustainability of high current deficits in Turkey. After the global financial crisis, short-term liquidity abundance in international markets led to an increase in short-term capital inflows, rapid valuation of the Turkish lira, fast credit expansion, and a further increase in the current account deficit in Turkey. An important change with regard to current deficits in this period was that current deficit had previously been financed by long-term capital inflows, while it came to be financed by short-term capital inflows and portfolio investments in the post-crisis period. As a result, high current account deficits were now perceived as a main macroeconomic and financial risk and the Central Bank adopted a more flexible policy regime aiming at financial stability in addition to its policy of standard inflation targeting (Specialized Commission Report on Current Account Deficit in Turkey, 2014:1).

It is important to note that if the current deficit problem persists in the long run, it will be difficult for the country's economy to overcome this problem. Because the capital import required to finance this deficit increases the country's foreign debts. If imported capital is not used in such a way to obtain enough profits, then problems may arise in repayment of external debt. Thus, this may lead to turbulence in financial markets (Yaman, 2011:3). On the other hand, the fact that countries with low saving rates cannot finance their investments continuously with foreign savings makes these countries vulnerable to sudden stops or counter flows in capital inflows, or "potential" financial crisis countries.

Current deficit could be regarded as a deviation concerning external imbalance. Therefore, it is important to reveal the causality relationships between the macro aggregates that affect current deficit by considering the specific conditions of Turkey's economy. And the present study aims to reveal the causality relationships between the macro aggregates that affect current deficit using the conditional and partial Granger causality tests.

The study consists of three parts. The first part provides information about conditional and partial Granger causality tests; the second part involves empirical study; and the last part includes an evaluation and interpretation of the empirical results.

2. Conditional and Partial Granger Causality Tests

First inspired by Wiener in 1956 (Wiener, 1956), Granger causality ("G-causality" or "GC") concept was formalized in the context of linear vector autoregression (VAR) models in 1969. A time series x is said to "G-causes" y if y can be predicted better using the past values of both y and x (full model) if compared with the prediction of y with only the past values of y (restricted model) (Granger, 1969:424). That is to say, the causal influence of one time series on another can be conceived by the notion that the prediction of one time series is improved (prediction error is lowered) by incorporating knowledge about the other (Roelstraete, 2011). Hence, GC is, by design and purpose, a measure of causal effect, namely the reduction in prediction error when the causal interaction is taken into account, as compared to when it is ignored (Barrett, 2013:1).

In the G-causality analysis of systems with more than 2 variables, such systems must be treated carefully since confounding effects (e.g., exogenous environmental inputs and latent variables (Youssofzadeh, 2014)) and interaction effects completely change the nature of G-causality. The standard framework for GC has been very recently extended to the multivariate case, where predictor and dependent variables are no longer constrained to be univariate (Barrett, 2010).

When there are more than 2 variables (time series) in a system, the G-causality analysis by taking the variables in pairs and applying the procedure presented above in isolation from the rest of the variables, i.e., by omitting the

effects of the remaining variables in finding the G-causality between the variables in question may cause spurious G-causalities (the interaction between two time series may be indirect; i.e., it may be mediated by another time series. This is the case when the existence of GC is reported though no GC exists in reality. By the way, notice that it may be also the case that no GC is reported though there really exists a GC. Both of the cases may be regarded as spurious cases) (Ding, 2006). The unconditional G-causality statistic introduced above as the "bivariate GC" has the undesirable characteristic (in systems with more than 2 variables) that if there are joint (possibly historical) dependencies between x and y and a third set of variables, z say, then spurious causalities may be reported. Thus, for instance, if there is no direct causal influence y→x but there are (possibly lagged) dependencies of x and y on z then a spurious y→x causality may be reported. These spurious causalities may be eliminated by "conditioning out" the common dependencies – provided they are available in the data. If, however, there are dependencies on unknown (exogenous) or unrecorded (latent) variables, then it will in general be impossible to eliminate entirely their potentially confounding effect on causal inference, although attempts have been made to mitigate their impact (e.g. partial G-causality (PGC), global G-causality etc.) (Barnett, 2014:53). To solve the problem of spurious G-causality, various advanced G-causality tools were proposed such as conditional multivariate G-causality (CGC), partial multivariate G-causality (PGC) (Guo, 2008:79; Roelstraete, 2011), etc.

Though comprehensive handling of advanced GC tools are beyond the scope of this paper, we will give a brief introduction to them.

2.1. Conditional G-Causality (CGC)

In systems with more than 2 variables in which the data of the variables are recorded simultaneously, the causal relation between any two of the time series of the system may be (a) direct, (b) indirect, i.e., mediated by a third one (c) a combination of both direct and indirect (Liao, 2011:2684). CGC is one of the measures of direct functional connectivity. Let x_t, y_t, z_t be three time series. The joint AR representation for x_t and z_t can be written as:

$$\begin{aligned} x_t &= \sum_{i=1}^{\infty} a_{1i}\, x_{t-i} + \sum_{i=1}^{\infty} c_{1i}\, z_{t-i} + \varepsilon_{1t} \\ z_t &= \sum_{i=1}^{\infty} b_{1i}\, z_{t-i} + \sum_{i=1}^{\infty} d_{1i}\, x_{t-i} + \varepsilon_{2t}. \end{aligned} \tag{1}$$

In order to check whether y G-causes x conditional on z (given z), the model is extended to the following VAR system:

$$\begin{aligned} x_t &= \sum_{i=1}^{\infty} a_{2i}\, x_{t-i} + \sum_{i=1}^{\infty} b_{2i}\, y_{t-i} + \sum_{i=1}^{\infty} c_{2i}\, z_{t-i} + \varepsilon_{3t} \\ y_t &= \sum_{i=1}^{\infty} d_{2i}\, x_{t-i} + \sum_{i=1}^{\infty} e_{2i}\, y_{t-i} + \sum_{i=1}^{\infty} f_{2i}\, z_{t-i} + \varepsilon_{4t} \\ z_t &= \sum_{i=1}^{\infty} g_{2i}\, x_{t-i} + \sum_{i=1}^{\infty} h_{2i}\, y_{t-i} + \sum_{i=1}^{\infty} k_{2i}\, z_{t-i} + \varepsilon_{5t}. \end{aligned} \tag{2}$$

($\varepsilon_{\mathrm{i}t}$, $i = 1, \ldots, 5$ are the prediction error, which are uncorrelated over time). Conditional GC from y to x conditioned on z is (Figure 1):

$$F_{y \to x|z} \equiv \ln\left(\frac{\mathrm{var}(\varepsilon_{1t})}{\mathrm{var}(\varepsilon_{3t})}\right). \tag{3}$$

In (2), when the G-causal effect from y to x is entirely caused (mediated) by z, the $b_{2t} \equiv 0$ and $\mathrm{var}(\varepsilon_{1t}) = \mathrm{var}(\varepsilon_{3t})$; that's why, $F_{y \to x|z} \equiv 0$, i.e., the past values of y cannot improve the prediction of the current value of x conditioned on z. When there is a direct effect from y to x over the one caused by the mediation of z, the inclusion of past values of y in addition to that of x and z improves the prediction of the current value of x; hence, $\mathrm{var}(\varepsilon_{1t}) >$

$\mathrm{var}(\varepsilon_{3t})$ and $F_{y\to x|z} > 0$.

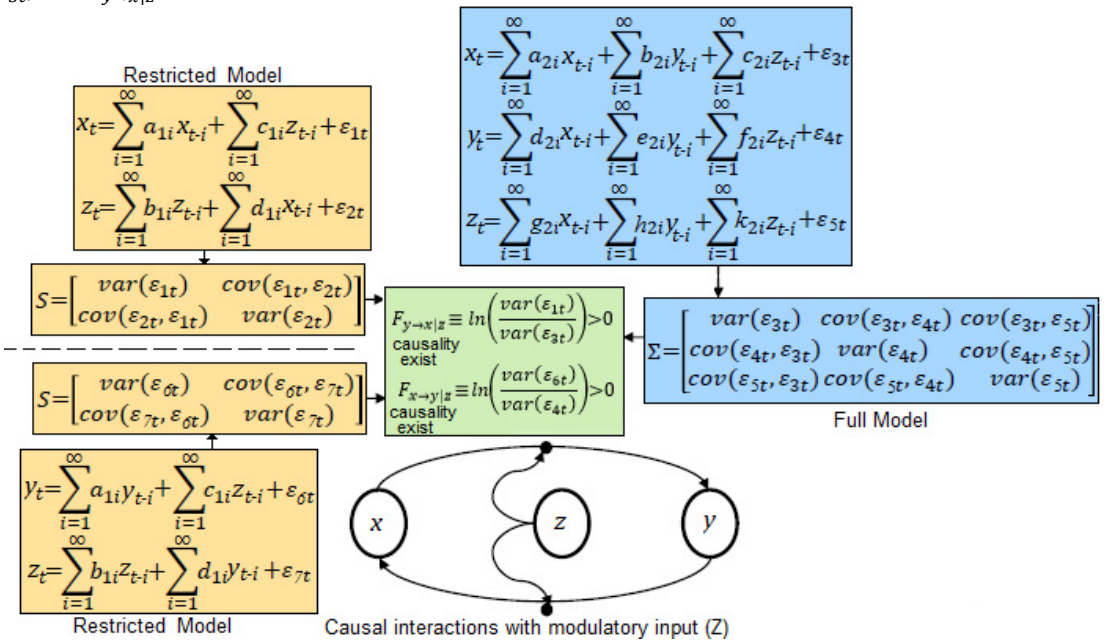

Figure 1. Conditional G-causality (developed from (Youssofzadeh, 2013).

2.2. Partial G-Causality (PGC)

Conditional GC (CGC) cannot deal with systems which contain an unobserved common input (Zou, 2010), i.e., CGC is effective only when all relevant variables in a network are observable. This is practically impossible, since both environmental inputs and unmeasured hidden variables can obscure accurate causal connections (Wu, 2012). To solve this issue, partial GC (PGC; denoted as F' to distinguish both) – another measure of direct functional connectivity – was defined (Guo, 2008:79). Time-domain partial GC specifically reduces confounding effects (exogenous environmental inputs and unmeasured endogenous latent variables) (Here, note that global GC (GGC) reduces the confounding effects more than PGC since GGC takes into account that external effects may be of differing magnitudes). PGC modifies the standard GC measure by adding terms based on residual correlations between the predicted and the conditional variables (Guo, 2008:79; Youssofzadeh, 2014). Thus, in the PGC, one makes use of the residual covariance matrix of the VAR unrestricted model (Σ) and the residual covariance matrix of the VAR restricted model (ρ). PGC is given as:

$$F'_{x_2\to x_1|x_3} \equiv \frac{\rho_{11} - \rho_{12}\rho_{22}^{-1}\rho_{21}}{\Sigma_{11} - \Sigma_{13}\Sigma_{33}^{-1}\Sigma_{31}}.$$

PGC constitutes an improved estimation of the direct Granger causality as compared to CGC when the residuals of the VAR models are correlated; otherwise, PGC is identical to the CGC (Papana, 2013:2638). The estimation procedure for PGC is described analytically in Guo's work (Guo, 2008:79).

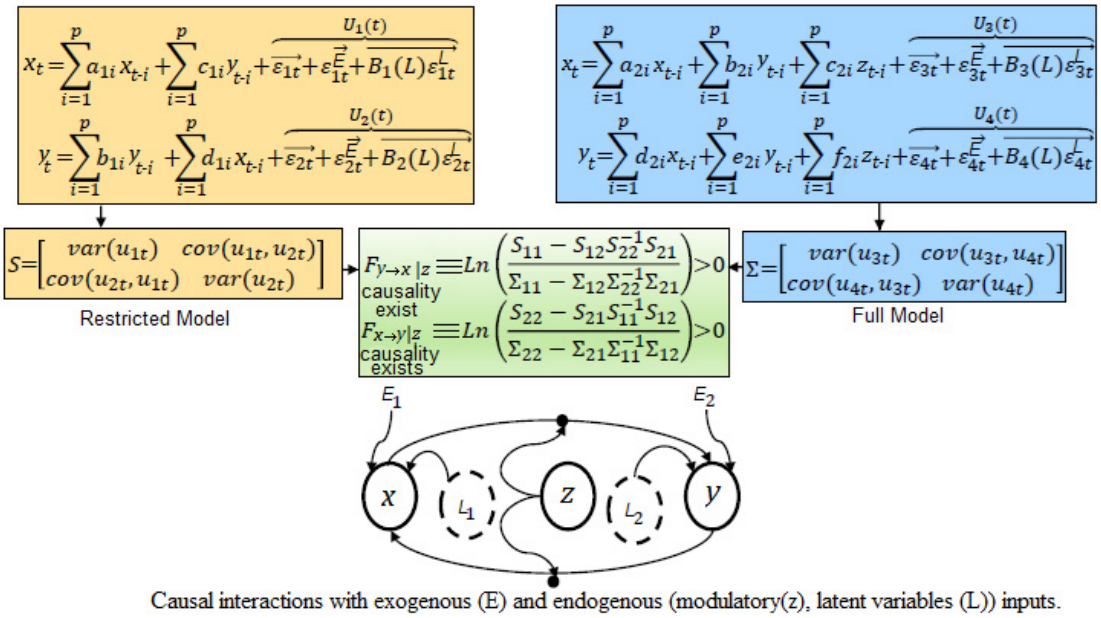

Figure 2. Partial G-causality (Youssofzadeh, 2013).

3. Empirical Study

The present study aims to reveal the causality relationships between the macro aggregates that affect current deficit using the partial Granger causality test.

The dataset of the determinants of Current Account Deficit (CAD) of Turkey has 6 variables: The ratio of current account deficit to gross domestic product (CAD/GDP) (%), real effective exchange rate (TRY/USD; the index of the year 2003 is taken as 100), growth rate (%), trade openness (%) (i.e., ((export+import)/GDP)*100), foreign direct investment (FDI) in Turkey (in billions dollars), and the energy imports of Turkey (in billions dollars)[1]. The range of the observations is 2003Q1-2014Q2, i.e., there are 46 observation points. The data is raw data in the sense that both nonstationary and stationary variables may exist.

The analysis started with a unit root test. The unit root test (Augmented Dickey-Fuller (ADF)) was applied to determine the stationarity of the series and the results of the unit root test are given in Table 1.

Table 1. Results of the ADF Test

	Variables	type	level	Pr	type	1stDiff	Pr	intoerder
1	CAD_GDP	dt	-3.925	*				I(0)
2	ExcRate	dt	-2.741		dt	-5.947	*	I(1)
3	GrowthRate	dt	-4.243	*				I(0)
4	openness	dt	-0.556		dt	-5.901	*	I(1)
5	FDI	dt	-5.218	*				I(0)
6	EnergyImp	dt	-0.334		dt	-4.24	*	I(1)

Note: Variables: CAD/GDP, Exchange Rate, Growth Rate, Trade Openness, FDI, and Energy Imports. In ADF regression, the results were given in the presence of "both drift and time trend (dt)". Seasonal effects were removed from the Growth Rate and CAD_GDP * Rejection of the unit root hypothesis at the 5% level.

[1]Numerous studies have been conducted on the determinants of current account deficit both locally and abroad. Erkılıc (2006), Seyfettin (2009), Morsy(2009), Peker(2009), Yang(2011), Candemir(2011), Bayraktutan (2011), Gocer(2012), Ciftci (2013), Trachanass (2013), Aydanur (2014).

As seen in Table 1, the variables of current account deficit, growth rate, and FDI are found to be stationary in level at a significance level of 5%. Exchange rate, trade openness, and energy imports are first-order difference stationary.

Since windowing techniques are not employed, all the nonstationary variables were stationarized in order to perform G-causality analysis (Seth, 2015). Note that the differences of variables can act just like the logarithms of levels as the representatives of variables by the very definition of G-causality (if every sudden change in explanatory variable causes to the changes (when compared to the moments with no sudden change) in the result variable just after the sudden changes in accordance with these sudden changes of explanatory variable, then the explanatory variable is the G-cause of the result variable; logarithms, differences etc. change in accordance with the change in levels).

Conditional Granger causality test is applied so that one can look at and interpret the causality relationships between variables. First, a convenient lag length is identified, which was determined as k=1 according to Schwarz information criterion. Figure 3 shows the results of the conditional Granger causality test.

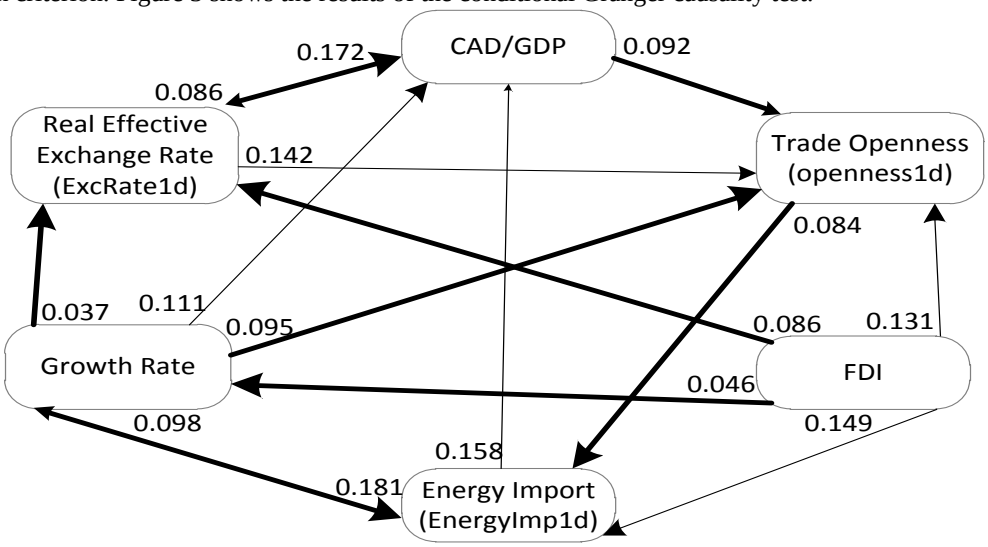

Figure 3. Network topology for the pairwise conditional G-causalities of 6-variable system with p values.

Figure 4 shows the results of the partial Granger causality test.

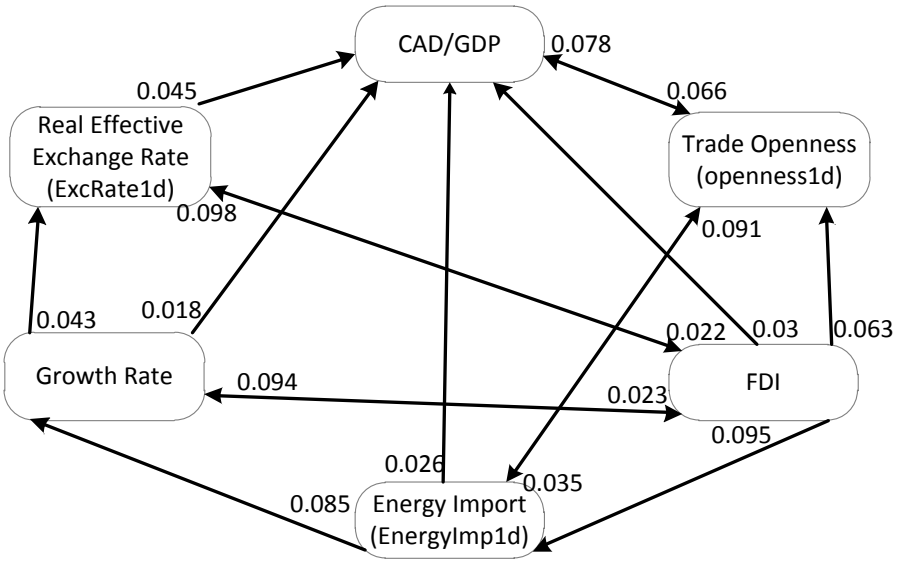

Figure 4. Network topology for the pairwise partial G-causalities of 6-variable system with p values.

The analysis also revealed the order of the 6 variables in the system in terms of affecting the other variables conditional on the remaining four during 2003Q1-2014Q2: GrowthRate (the most effective), FDI, ExcRate, CAD/GDP, EnergyImp, and openness.

4. Conclusion and Suggestions

This study aims to reveal the causality relations between the macro aggregates that affect current deficit using conditional and partial Granger causality test. Current deficit/GDP, growth rate, real effective exchange rate, direct foreign capital investment, trade openness, and energy import were selected as variables for this purpose. 2003.1-2014.2 quarterly data for Turkey's economy were used for analysis.

We employed causfinder (the 1st tool in R for the systemwise analysis of conditional and partial GCs) for the analysis we performed and obtained the values of the GC statistics, directions, etc. as well as the degrees of causations.

The results of the conditional and partial Granger causality test demonstrate that real effective exchange rate is the variable with greatest impact on current deficit/GDP. Exchange rate is followed by the growth rate, energy import, and trade openness variables. And direct foreign capital investment is the variable with the least impact.

Since current account deficit is mainly caused by foreign trade deficit in Turkey, it is assumed that a devaluation of real exchange rate may result in narrowing of the foreign trade deficit and thereby the current account deficit, while in the reverse situation, an increase in the value of real exchange rate would widen foreign trade deficit and thereby the current account deficit. Particularly after the 2000s, with overvaluation of TL as a result of inflation targeting in Turkey's economy, foreign trade deficit widened, which in turn increased the current account deficit. Following the 2001 crisis in particular, high economic growth led to an increase in current account deficit; however, there was a persistent need for external sources since domestic savings were not enough to finance the real economic growth. Throughout the 2000s, short-term speculative capital inflows stimulated by high interest/low exchange rate financed public and/or private sector deficits through external savings on one hand and created a pressure to increase current deficit by expanding the import and consumption volume for national economy (by reducing savings) through the national currency that gained value, low competitive power, and credit expansion.

Increased dependence of Turkey's economy on import in its production and export has promoted economic growth; yet, such increase in economic growth based on imports has also increased current account deficit. Nevertheless, Turkey is foreign-dependent for 70 percent of energy, the most significant input for production.

Rapidly increasing energy demand on one hand and foreign-dependence on energy on the other constitute another factor that increases current account deficit.

Direct foreign capital investments not only ensure an inflow of foreign currency by bringing their original capital with them, but they also positively influence the country's current account balance with their exports. In this regard, direct foreign capital investments used to finance current deficit constitute another determinant of current account deficit. However, the impact of direct foreign capital investments upon current accounts has been found to be lower when compared to other variables. This is attributed to the marked decline in direct foreign capital investments after 2009.

Defined as a measure of an economy's foreign expansion in trade, the openness rate is also influential on current account deficit. If the share of foreign trade in domestic income is high and has a rising trend, then it means that international circulation of goods and services is also on the rise. In this respect, along with exchange rate, growth rate, energy import, and direct foreign capital investments, openness rate is a determinant of the current account deficit.

In view of the above,

- In addition to policies adopted to increase Turkey's competitive power, the country should also adopt industrial policies that could reduce the industry's dependence on imports in intermediate goods in particular and increase the share of domestic production.
- There is a need to develop alternative energy sources in order to reduce dependence on oil, which has a very high share in both total imports and energy imports.
- To narrow the foreign trade deficit in the long run, it would be very useful both to increase trade with newly emerging markets and to implement policies promoting export in competitive sectors.
- It is highly risky to finance current deficit by short-term capital inflows. Therefore, it is significantly important to promote long-term foreign capital investments.
- There is a need to implement energy-saving policies in industries with high energy demand both in the short and medium term and to use alternative energy sources.
- Efforts should be made to attract more direct foreign capital investments to the country and foreign investors operating in the country should be encouraged to invest their profits locally, instead of transferring them to their countries.
- Increasingly declining saving rates are among the main phenomena that has recently contributed to the increase in current account deficit in Turkey's economy. Thus, there is a need to introduce policies that may help increase the saving rates.

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